

Discounting The Future - Part III

Valuing Common Stock

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In this white paper we will use the mathematics of valuing a perpetual bond to valuing common stock. To that end we will work through the following hypothetical problem...

Our Hypothetical Problem

We are tasked with valuing common stock of ABC Company. The table below presents our model parameters...

Description	Value
Balance sheet operating assets	\$1,000,000
Number of common shares	10,000
Number of annual dividend pmts	1
Annual return on assets	12.00 %
Annual asset growth rate	3.50 %
Annual real rate of return	2.25 %
Annual inflation rate	2.75 %
Annual risk premium	4.75 %

We will define the variable A_t to be operating assets at the end of time t and the variable g to be the annual asset growth rate. The equation for operating assets at the end of time t as a function of operating assets at time zero is...

$$A_t = A_0 (1 + g)^t \quad (1)$$

We will define the variable N_t to be annual after-tax net income and the variable w to be the after-tax return on assets (ROA). Using Equation (1) above and the table above, the equation for net income is...

$$N_t = \text{Operating assets at the beginning of time } t \times \text{After-tax ROA} = w A_{t-1} = w A_0 (1 + g)^{t-1} \quad (2)$$

Operating assets increase the annual asset growth rate. We will define the variable X_t to be balance sheet investment at the end of time t . Using Equation (1) above and the table above, the balance sheet investment is...

$$X_t = \text{Operating assets at the beginning of time } t \times \text{Asset growth rate} = g A_{t-1} = g A_0 (1 + g)^{t-1} \quad (3)$$

We will define the variable k to be the annual market interest rate. The market interest rate is the interest rate that the market demands to buy this bond. Using the table above, the market rate calculation is...

$$k = \text{Real rate of return} + \text{Inflation rate} + \text{Risk premium} = 0.0225 + 0.0275 + 0.0475 = 0.0975 \quad (4)$$

Building Our Model

We will define the variable V_0 to be the market value of common equity at time zero. The equation for common equity value is...

$$V_0 = \text{Value of after-tax net income} - \text{Value of balance sheet investment} \quad (5)$$

We will define the variable S_0 to be share price at time zero and the variable N_0 to be the number of common shares. The equation for share price is...

$$S_0 = \text{Share price} = \frac{V_0}{N_0} \quad (6)$$

Using Equations (1), (2), (3) and (4) above, the equation for common equity value at time zero is...

$$V_0 = \frac{N_1 - X_1}{(1+k)^1} + \frac{N_2 - X_2}{(1+k)^2} + \frac{N_3 - X_3}{(1+k)^3} + \dots + \frac{N_\infty - X_\infty}{(1+k)^\infty} \quad (7)$$

Note that we can rewrite Equation (7) above as...

$$V_0 = \sum_{t=1}^{\infty} \frac{N_t - X_t}{(1+k)^t} = \sum_{t=1}^{\infty} \frac{(w-g) A_0 (1+g)^{t-1}}{(1+k)^t} = \frac{w-g}{1+g} A_0 \sum_{t=1}^{\infty} \left(\frac{1+g}{1+k} \right)^t \quad (8)$$

Using the white paper on valuing perpetual debt, the solution to Equation (8) above is... [1]

$$V_0 = (w-g) A_0 \frac{1}{k-g} \quad \dots \text{when} \dots \quad w > g \quad (9)$$

Note that if $w = k$ then the value of common equity at time zero is the operating assets (i.e. goodwill is zero). Using Equation (9) above, this statement in mathematical terms is...

$$V_0 = (k-g) A_0 \frac{1}{k-g} = A_0 \quad \dots \text{when} \dots \quad w = k \quad (10)$$

The Answer To Our Hypothetical Problem

Using Equations (4) and (9) above, the equation for the value of our discount factor is...

$$\theta = \frac{1+g}{1+k} = \frac{1+0.0350}{1+0.0975} = 0.94305 \quad (11)$$

Using Equations (9) and (11) above, the value of our bond coupon payments is...

$$\text{Value of net income} = w A_0 \frac{1}{k-g} = 0.1200 \times 100,000 \times \frac{1}{0.0975 - 0.0350} = 192,000.00 \quad (12)$$

Using Equations (9) and (11) above, the value of our bond principal payments is...

$$\text{Value of balance sheet investment} = g A_0 \frac{1}{k-g} = 0.0350 \times 100,000 \times \frac{1}{0.0975 - 0.0350} = 56,000.00 \quad (13)$$

Using Equations (5), (12) and (13) above, the value of our term bond is...

$$\text{Value of common equity} = 192,000.00 - 56,000.00 = 136,000.00 \quad (14)$$

Using Equations (6) and (14) above, our share price is...

$$\text{Share price} = \frac{136,000.00}{10,000} = \$13.60 \quad (15)$$

References

[1] Gary Schurman, *Discounting The Future - Valuing A Perpetual Bond*, May, 2026